LOCK ON N°17

AIRCRAFT PHOTO FILE

Su-27 'SUKHOI'

734

Robert SENKOWSKI
& Cezary PIOTROWSKI

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VP
the world in scale
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Cover : Sukhoi Su-27 'Flanker A' heading for the runway, lacking all underwing stores but finished in the standard Soviet camouflage scheme.

Title page : Sister ship "02" having been serviced on the apron, ready for another sortie. Sukhoi physical appearance closely resembles the MIG-29 except for the vertical tale surfaces, devoid of the front fairings.

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Clearly state name and address when sending in your material.

INTRODUCTION

Whenever it came to handing out awards for the most sophisticated looking aircraft, Soviet designers never took the front row and they did not seem to care the least. They knew most of their designs had to do without the technical know-how and high class basic materials of the west, so they concentrated on design specifications such as speed and survivability.

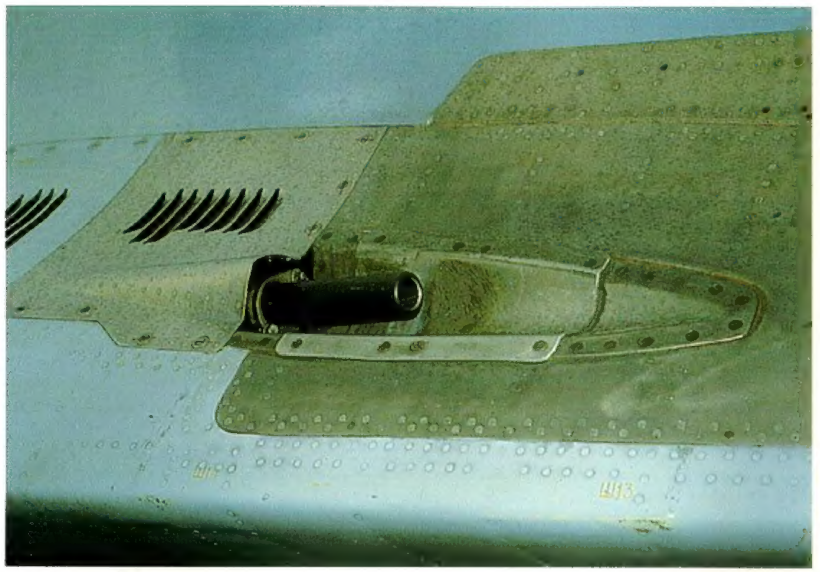
However, today's Soviet fighters benefitted from western information and hardware, obtained through various sources, and equal or outscore the flight performances of western designs such as the F-16, F-15 and even the F-14. Still it is believed they are way behind in the field of target aquisition and related software. Western pilot's even claim to have the edge over their counterparts in the east when it comes to aerial combat tactics. Whatever the case, the Sukhoi SU-27 (NATO codename Flanker) and the MIG-29 are fighters of a new era, beautiful aircraft both on the ground and in the air with amazing maneuverability characteristics and a firepower to reckon with in air-to-air combat. Believed to be designed in the mid 70's with flight testing taking place in 1977, the Su-27 design kept western analysists busy until the first real sighting was reported by a Norwegian P-3 Orion on 13 September 1987 when intercepted by two Sukhoi's over the Barents Sea.

Nowadays the Sukhoi Su-27, which by fighter aircraft standards is a big aircraft, is a regular contender of airshows in the west where it stunned spectators on its first public display by performing the "Cobra" or tail-slide maneuver (Paris, 1989) without disgracefully crashing in front of the crowd. It takes a good design to maneuver from level flight to a nose-up positon of 120° (well beyond the vertical), flying tail first and pitching forward again to regain level flight without appreciable loss of altitude. Whether this maneuver can be desicive in air-to-air combat is questioned by many NATO pilots but the fact remains the Su-27 Sukhoi is a fighter to be reckoned with in the future.

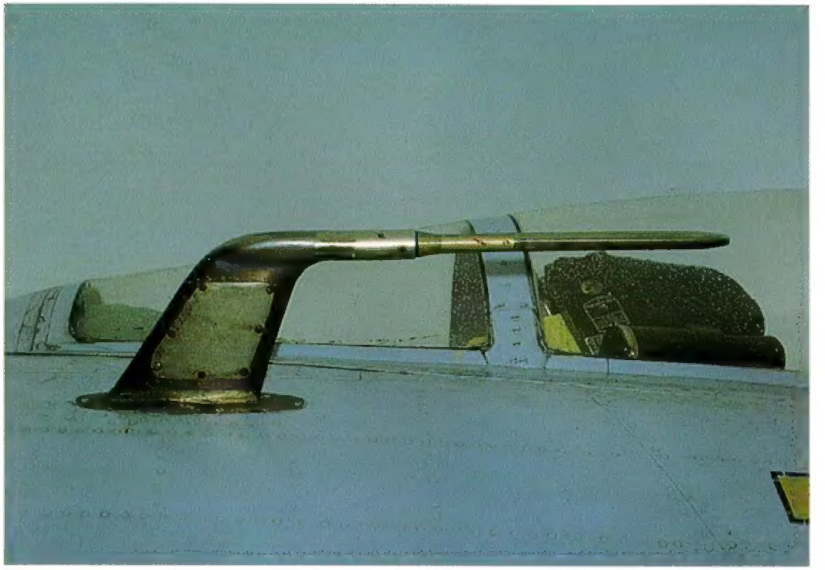
Forward fuselage section clearly showing the three-piece canopy with fuselage-incorporated framing and the high cockpit setting, giving excellent all-round visibilty.
The white radome is not standard but does seem to appear on several occasions. Note the angle-of-attack sensor vane just in front of the red/white number "31".

The nose cone-mounted pitot tube through which valuable atmospheric and speed-related information reaches the flight control computers, subsequently transferred to the pilot's instrument panel. Apart from the light blue section, the pitot tube is bare metal overall. Note the red marker on each and every screw.

Below the nose "Odd Rod" type IFF (Identification Friend or Foe) antennas and TACAN antenna with most forward an additional angle-of-attack sensor vane of which several can be found on the aircraft, serving the fly-by-wire system. Such a vane is rarely seen in this central position below the nose.

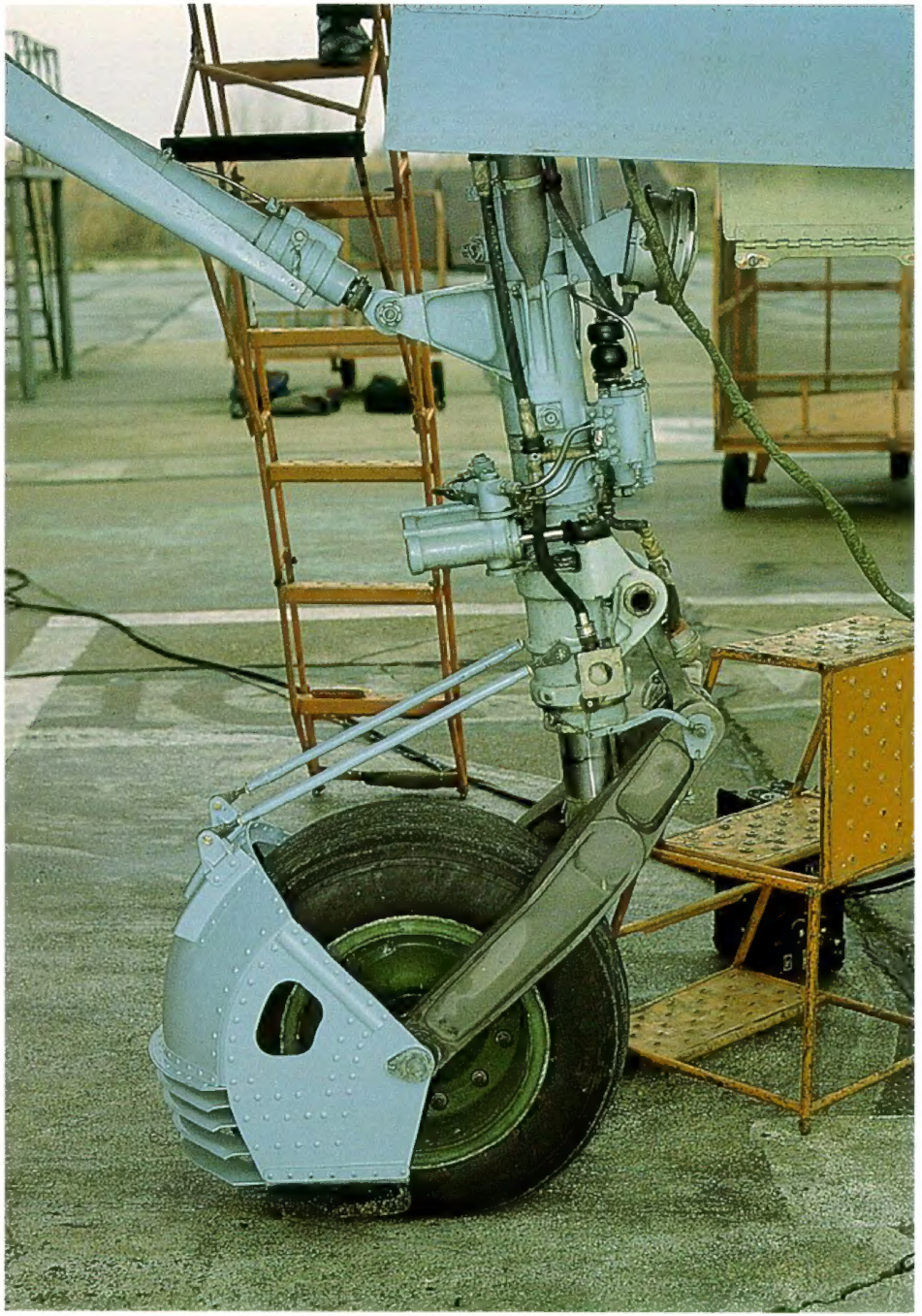


Close-up of the GS-301 30mm cannon muzzle area covered with titanium plating (the best heat-absorbing material). The louvers in the panel behind serve to diverge gun gas exhausts which build up during firing of the gun. A somewhat crude matching of panels occurs in this area, despite the aircraft's modern design.

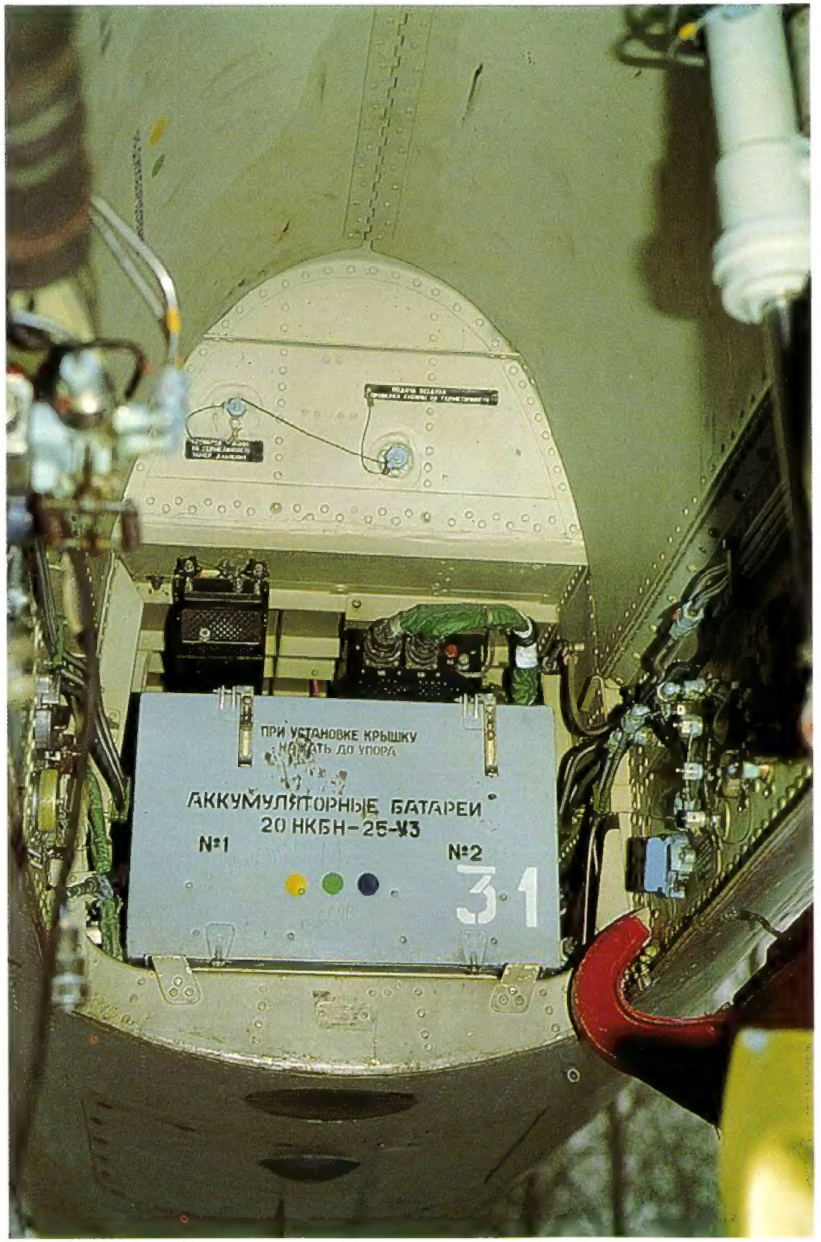


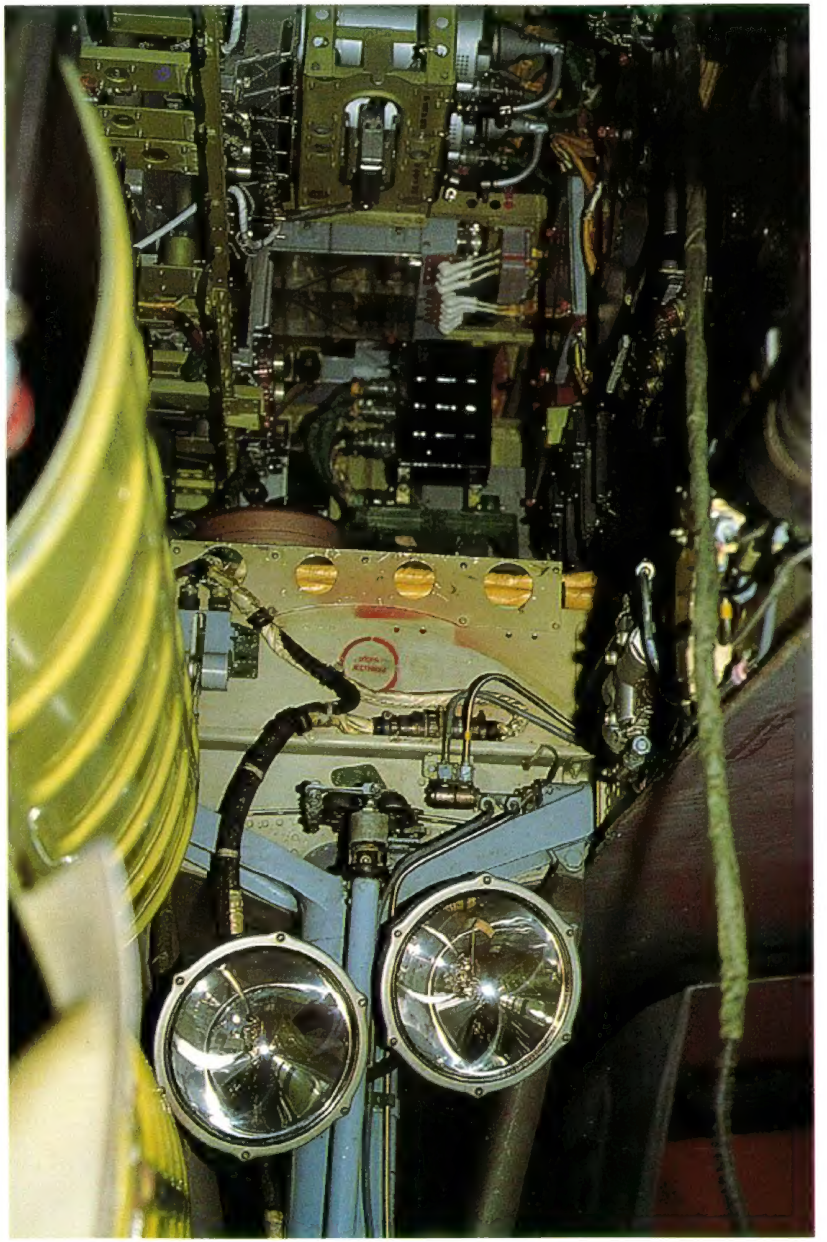
Two more static pitot tubes appear on the upper fuselage, on either side of the cockpit. Various maneuvers with different angles of attack (AoA) require input from various sources. Information is analyzed by the fly-by-wire flight control system and translated into flap and tailplane settings.

The Su-27, like the F-18 Hornet, features a leading edge extension (or LEX) however not faired with the full-span leading edge flap. To limit upward flap deflection a small pin aside the flap matches a notch in the LEX side. A significant advantage of the leading edge extensions and fuselage/wing blending is the creation of vortices that energizes the airflow over the outer wing panels, significantly increasing lift.



Especially designed for rough field operations the single wheel sturdy nose gear features a mud guard/FOD screen with downward facing deflector louvers guiding all debris away from the large air intakes. It pivots around the wheel axis and is connected to the nose gear leg by two struts. A green colored antenna is located just aft and to the left of the wheel well.

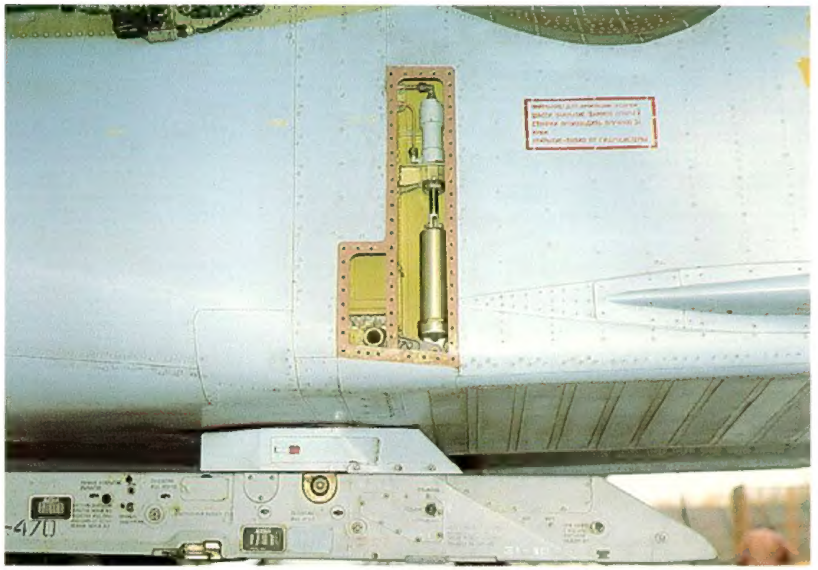




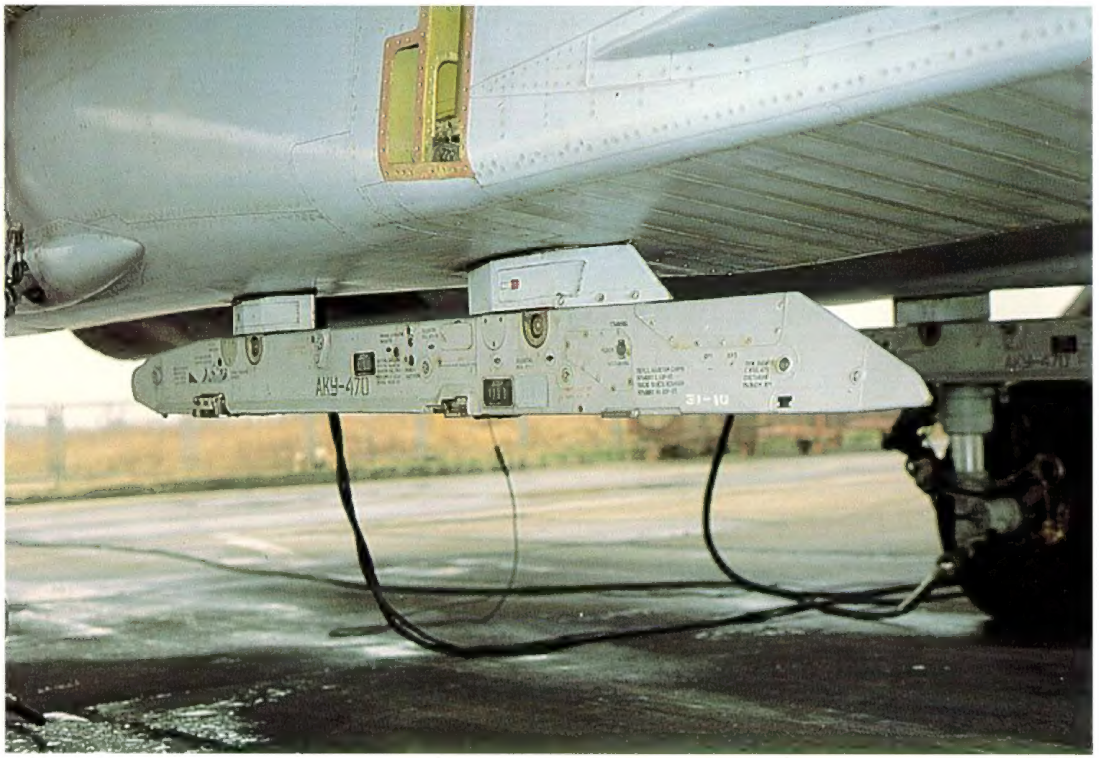
Wheel well interior looking forward. The Sukhoi nose gear is pushed straight forward into the bay by a single actuator which has an integral fairing which remains visible on the outside of the bottom fuselage once the gear is retracted.
A single retraction actuator closes the dual-hinged, single-piece nose gear door which is painted red on its inside surfaces. The N°1 and N°2 battery have been stored in this area, forward of the wheel well.

Dual landing lights are mounted high on the nose gear leg, well clear off debris encountered on rough terrain. Rather than having access panels cut in the aircraft's skin, the hinged roof of the nose wheel well can be removed to gain access to various connectors and system control boxes. The Sukhoi is designed with remote area operations in mind, with emphasis on self-sufficiency.
Note the light gray interior of the nose gear well.

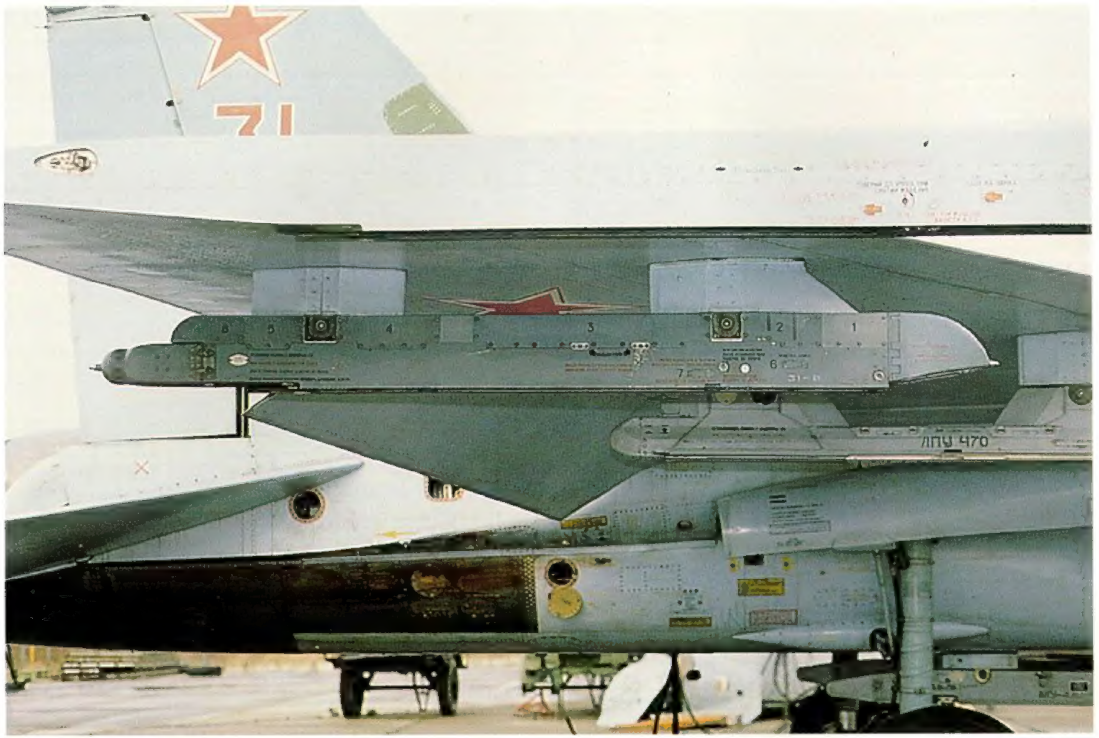
The aircraft features a "Sirena" radar warning antenna fairing on the bottom side of each intake, consisting of a dielectric front (painted green) and a metal aft part. Note the spring-loaded auxiliary intake slats on the bottom.



Inside each air intake is an FOD screen, hinged at the bottom and pneumatically operated by this actuator which can be maintained from this side. Note how the squared edge of the intake tapers into the actual engine nacelle.



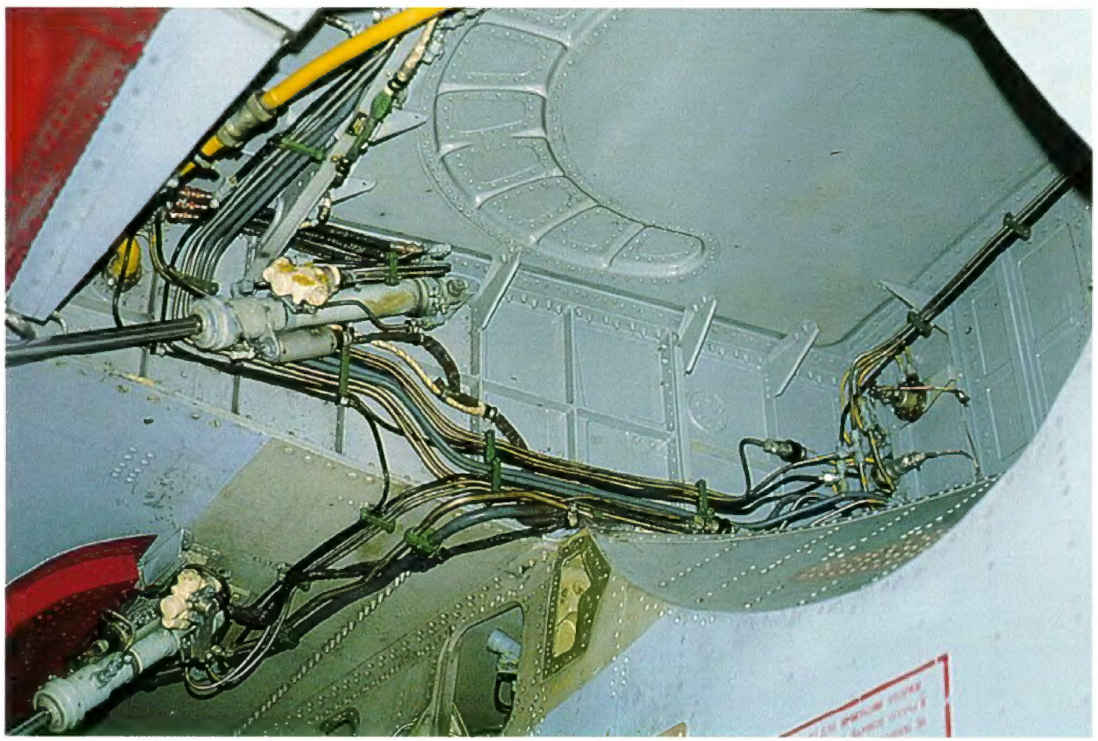
Ten hardpoints can be used to carry missiles, ranging from the AA-8 Aphid to the AA-11 for its air defense role with the limitation of 10 missiles being carried at any one time. One such pylon is installed below each air intake as this view shows.



Inside detail of the wingtip missile launch rail with split front cover. Note the alternate black and red inscriptions.

Top left and left The number 9 pylon used to carry AA-8 or AA-11 missiles. It differs considerably from the number 8 pylon in the background and at bottom left. Actually, underfuselage and underwing pylons are merely a combination of a single narrow beam or rack and two spaced subpylons attached to the wing. The reason for such a construction (instead of a larger, single-piece pylon like the F-16) could be the interchangeability of the subpylons between left and right wing and inner and outer pylon.
Note how the tip of the beam faces upward to give clearance to the missile when launched.

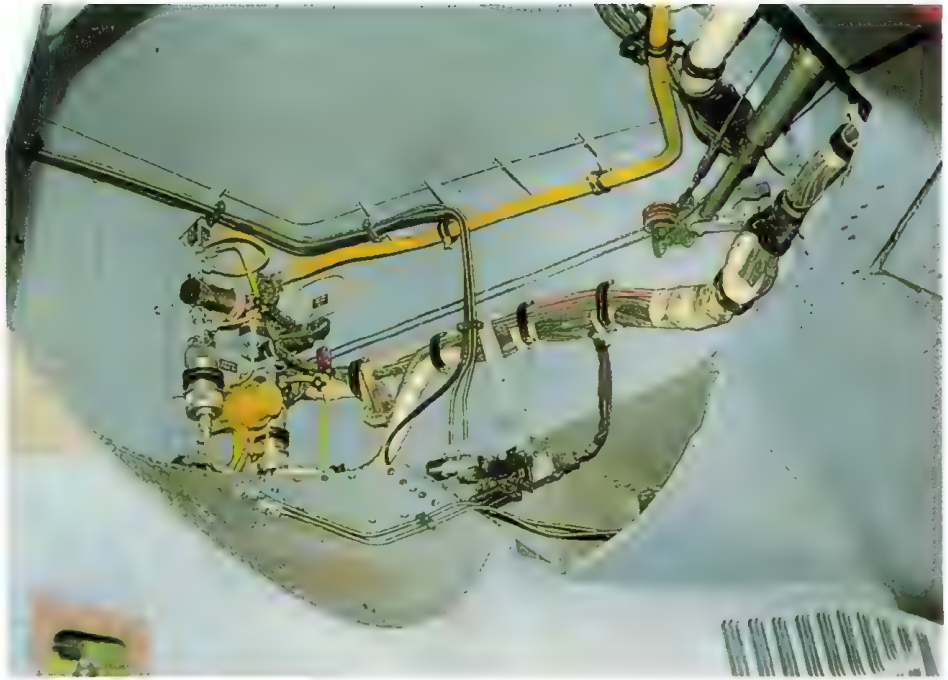
The Su-27 has no outboard ailerons but is equipped with single trailing edge flaperons, spanning half of the inboard wing. They are hydraulically actuated and controlled by the aircraft's fly-by-wire flight control system. Note the curved upper surface of the wingtip missile launcher, the position of the "red star" marking and the static dischargers on the outboard trailing edge.



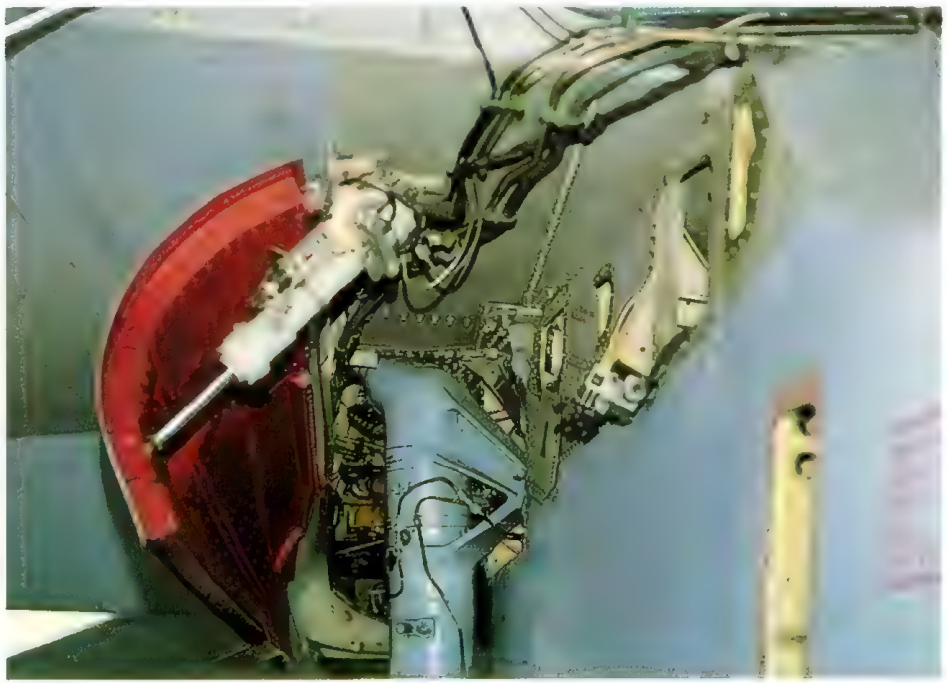
Top left Whereas wingtip missile launchers on western designed aircraft feature outboard facing launch rails, the Sukhoi missile launch rail is on the bottom side. A wingtip position light (seen here without cover) is installed on the aft part. Note the camouflage pattern, serial number and national insignia on the outboard vertical tail surfaces as well as the green dielectric panel on the vertical tail leading edge.

Left Main landing gear and gear compartment is also somewhat unusual with only the main wheel confined inside the fuselage while the main wheel leg folds tightly against the wing/fuselage joint to be covered by a concave door. Part of the fuselage treshold has been lowered to let the main wheel pass. Inner and aft sidewalls have structural strengtheners and apart from some pneumatic feed lines and electrical wiring little or no back-up systems can be found inside the well.

A single pneumatic actuator attached to the rear sidewall operates the main gear cover which is painted bright red on its inner surfaces. Note the moon-shaped embossing in the roof.
The main gear strut has only one swivel or hinge point as seen in the picture at right. The gear door locking device can be seen forward right.

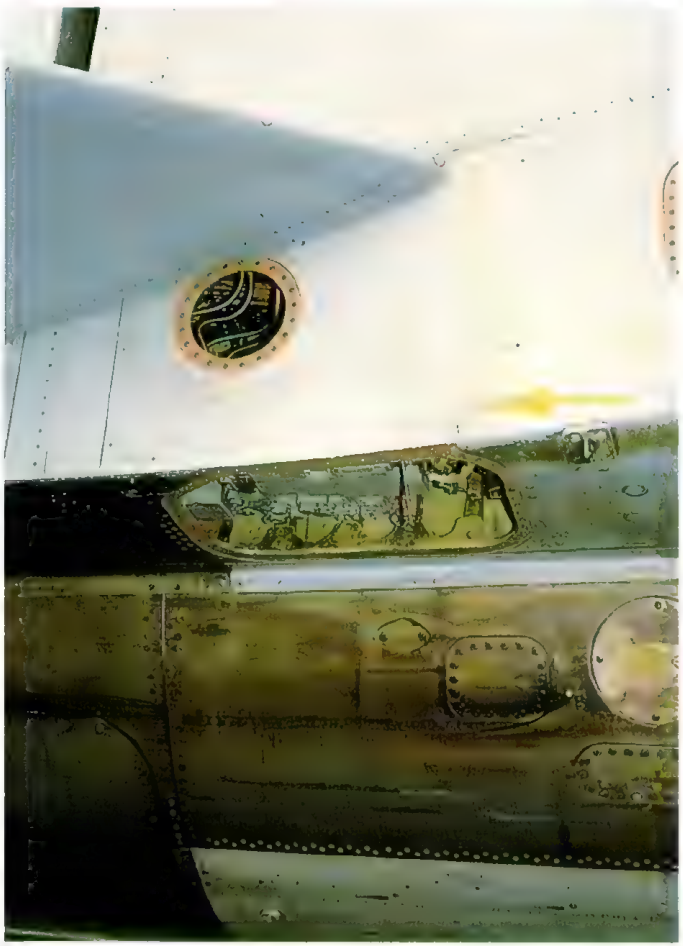


The main wheel well looking forward, distinctively showing the conical fairing at the wing root as part of the outside gear cover. To simplify identification of various supply lines each is painted a different color, common practice with Soviet aircraft. Also note the different colors of well.



Full side view of the main gear area with large gear door and its two hinge assemblies. A fairing at the bottom fuselage houses the gear downlock/fuselage attachment point.
The sturdy strut and over-inflated large tires are designed for touchdowns on unprepared landing strips or to withstand landings by inexperienced young pilots, for which purpose the main wheels are equipped with an integral cooling fan inside the wheel hub assembly to accomodate heavy braking requirements.
Some exhaust tubes, engine inspection panels and main refuelling panel are located on the starboard side, aft of the main landing gear.
Differently shaped inspection panels are located in the titanium covered part of the bottom engine nacelle.

Dark green dielectric panel covers communication antenna in the right fin tip with trailing edge antennas connected to onboard radar warning and navigation systems. Note seven aluminum rivets forming a distinctive triangle on both sides of the dielectrical panel.

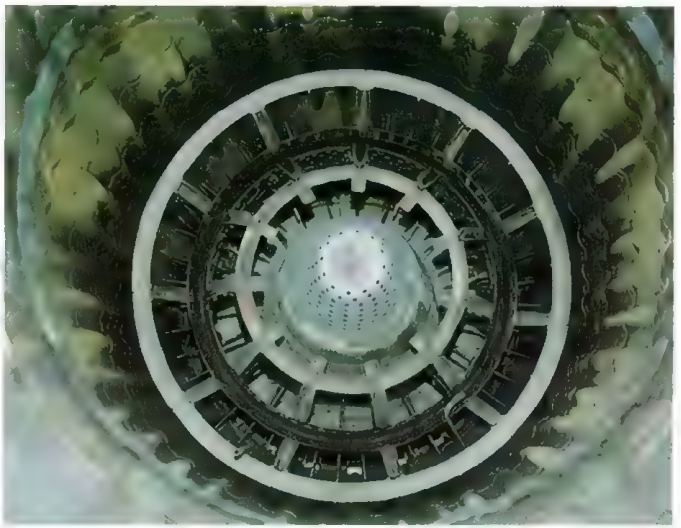


More inspection panels below the aft fuselage strake where the tailplane's arc-of-deflection is painted on the fuselage side. Very unusual is that part of the strake is an integral part of the tailplane, featuring an actuator fairing aft of the rudder panel.

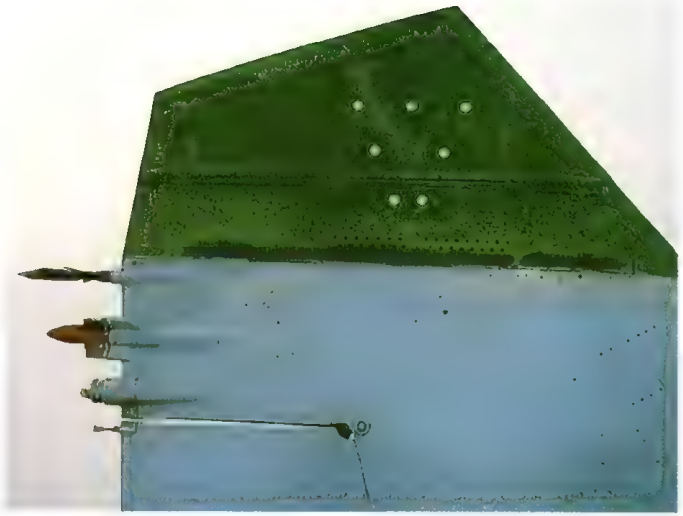
Perfect shot to show the Sukhoi's distinctively shaped upper surfaces with twin tailplanes, large engine nacelles and empennage. Current empennage designs include strakes terminating in dielectric covers for tail warning sensors. Wing flaps and tailplanes have drooped because of the absence of hydraulic power but rudders show no deflection. This view clearly shows the stabilator's surface area inside the vertical tail fairing and the limited view to the rear from the forward angled cockpit. Upper surface detail will be shown on pages 24 through 30.

Bottom view of the same showing the shape of the engine nacelles, tapering from a square cross section into a round, bulky engine housing. Handle in the bottom tail cone is related to the drag chute split housing. Apparent is the low position of the engines in relation to the rest of the fuselage.

The pointed tailcone viewed from the side with the Odd Rod type antenna on top and green tail warning sensors on the sides. Note the quick release inspection panel on the lower part of the cone, easy accessible from the ground.



Neatly faired engine exhaust nozzles with interfacing feathers. Exhaust interior with afterburner ignition rings and perforated cone is seen above. Note the chalk-written number on the cone remained intact despite the tremendous heat development inside.



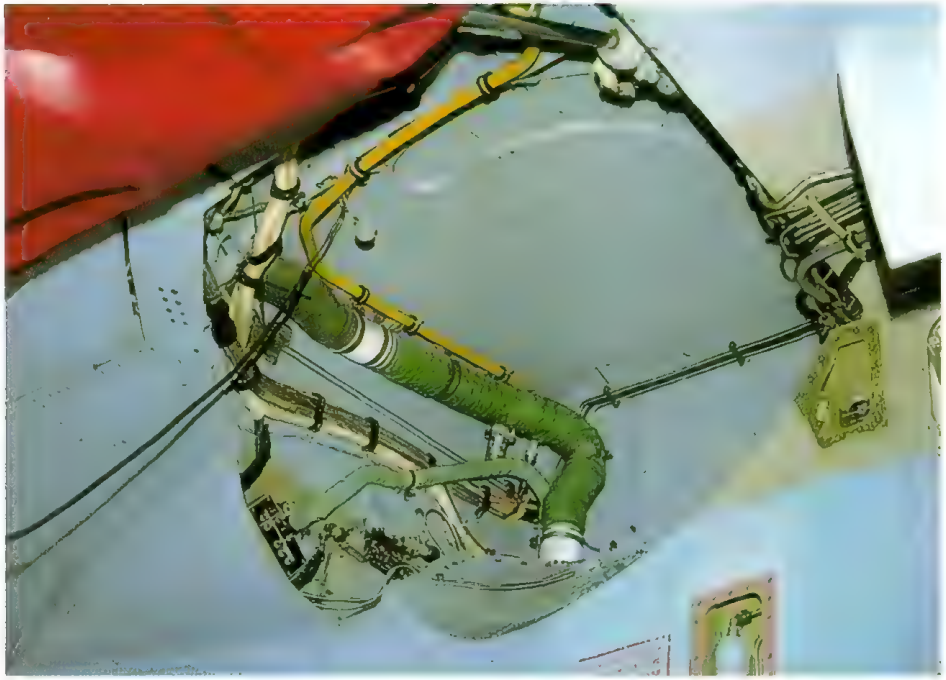
Top Slightly different antenna layout on the left vertical tail trailing edge but also serving radar warning and navigation purposes. Heavy discoloring is seen on the vertical tail surfaces, inside and outside.

Right Similar inspection panels can be found on the left outboard engine housing as those described on page 12. The yellow deflection marking reappears in front of the all-metal horizontal stabilizer which can be deflected seperately or in unison up to 40°.
Horizontal stabilizers, rudders and flaperons are integrated with each other through the flight control system.

Both sides of the aircraft have a large ventral fin mounted below the dorsal vertical. Although not installed on this particular a/c its location is marked just outside of the two bottom inspection openings (note discoloring of the fuselage and both attachment points). These ventral fins limit takeoff rotation angle to 17°.
Note space between horizontal tail and fuselage.

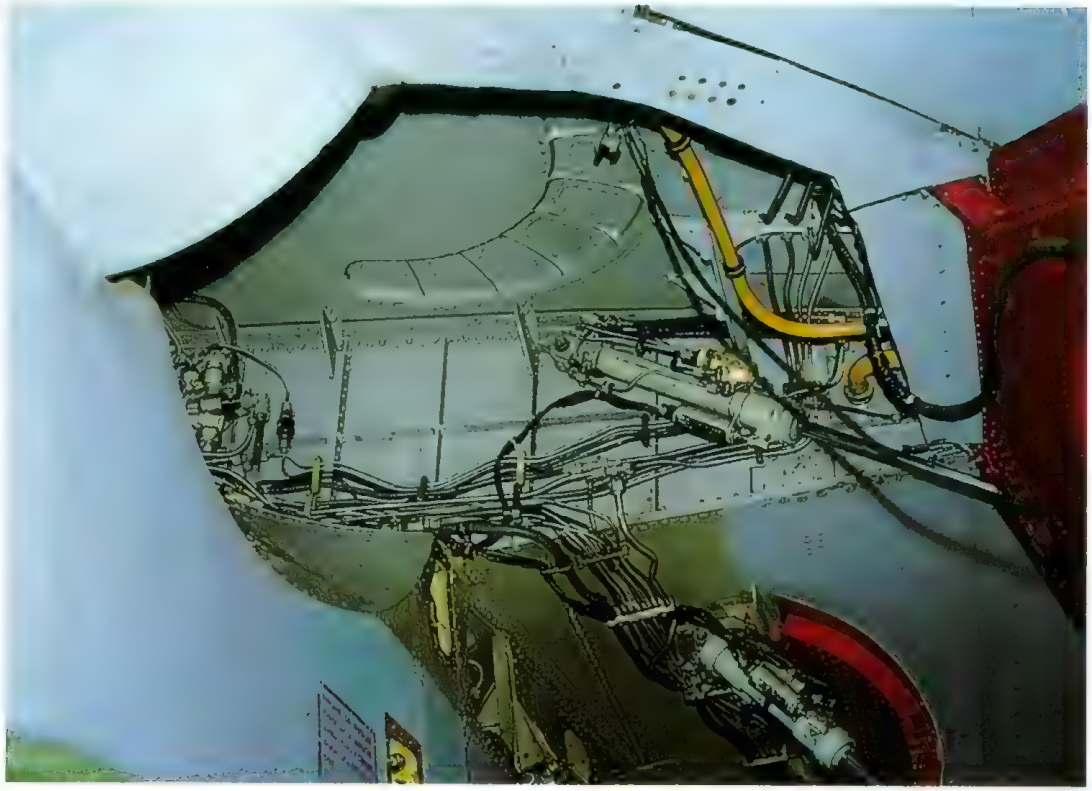
In order to reach some inspection panels located on the side of the vertical tail surfaces an exterior ladder is hooked-up inside two holes immediately below the unit marking. Note the hoisting point marking in front of the ladder and both markings representing a screw on the inspection panels. Application of different camouflage colors is apparent.

Sukhoi Su-27
'Flanker A'
Soviet VVS
(Photo via Robert SENKOWSKI)

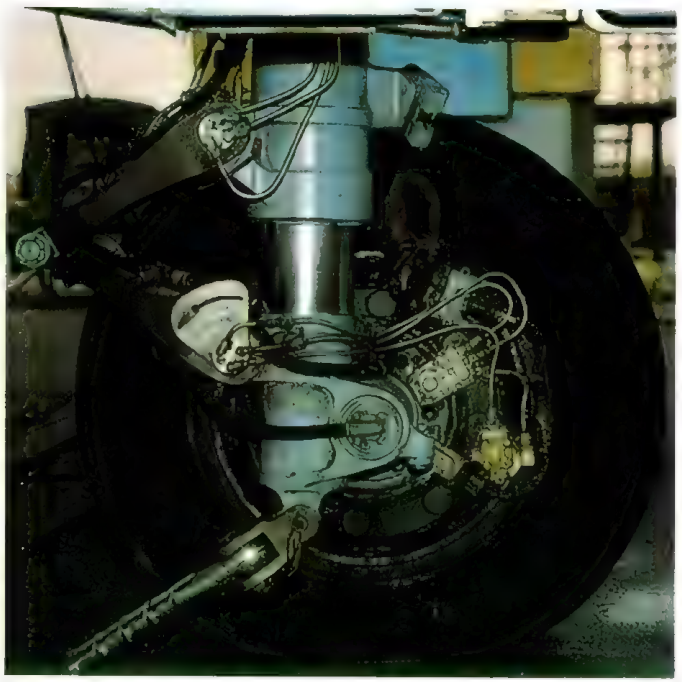


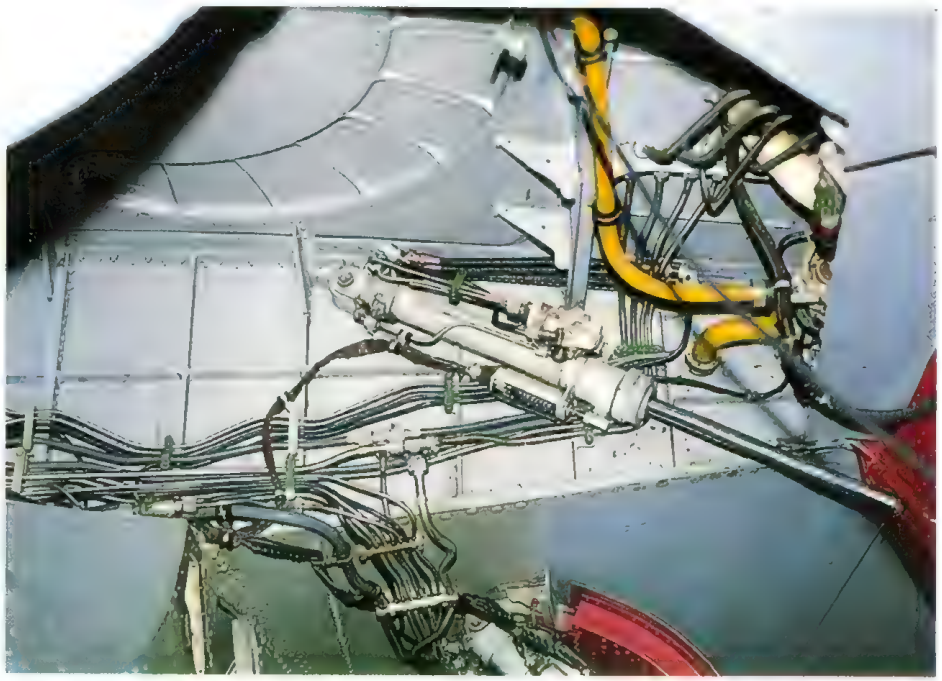
Top left and right Left side landing gear strut and wheel well interior closely resembles starboard side layout, except for the additional green hoses to the front wheel well bulkhead and the system control box inside the conical fairing at front.

Left External power receptacle is located on the left side bottom fuselage, just aft of the landing gear hook-up fairing with a small communications hook-up panel next to it. Note various markings.



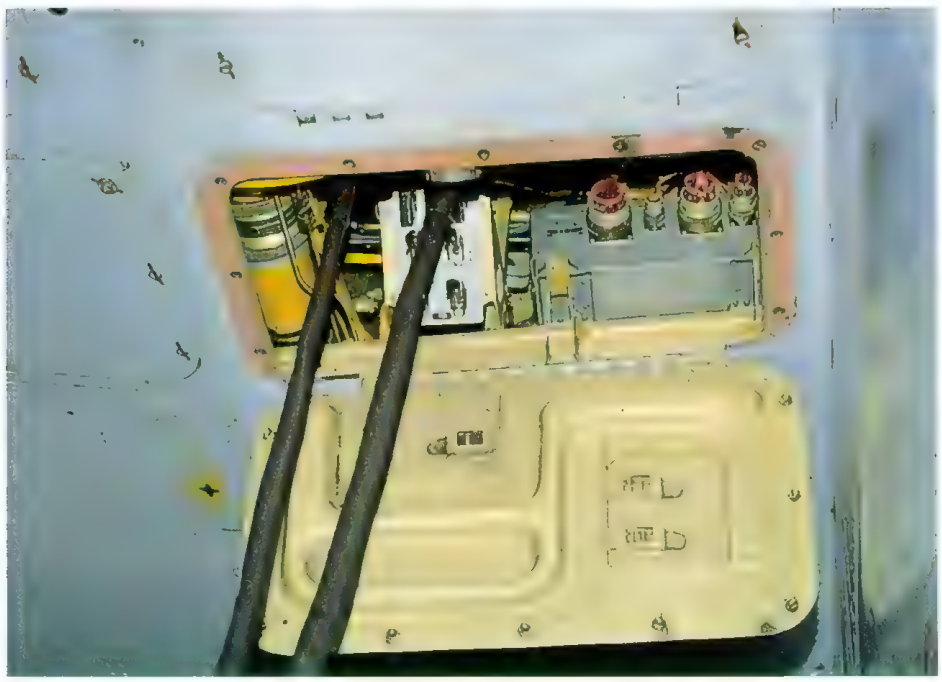
Further coverage of the left side main gear well holds no surprises, being a mirror image of the right side. The extra view on this page concentrates on the main wheel disc brake and eleborate inner wheel detail. Note the rather primitive system to measure the scissor downlink deflection in relation to the main oleo.



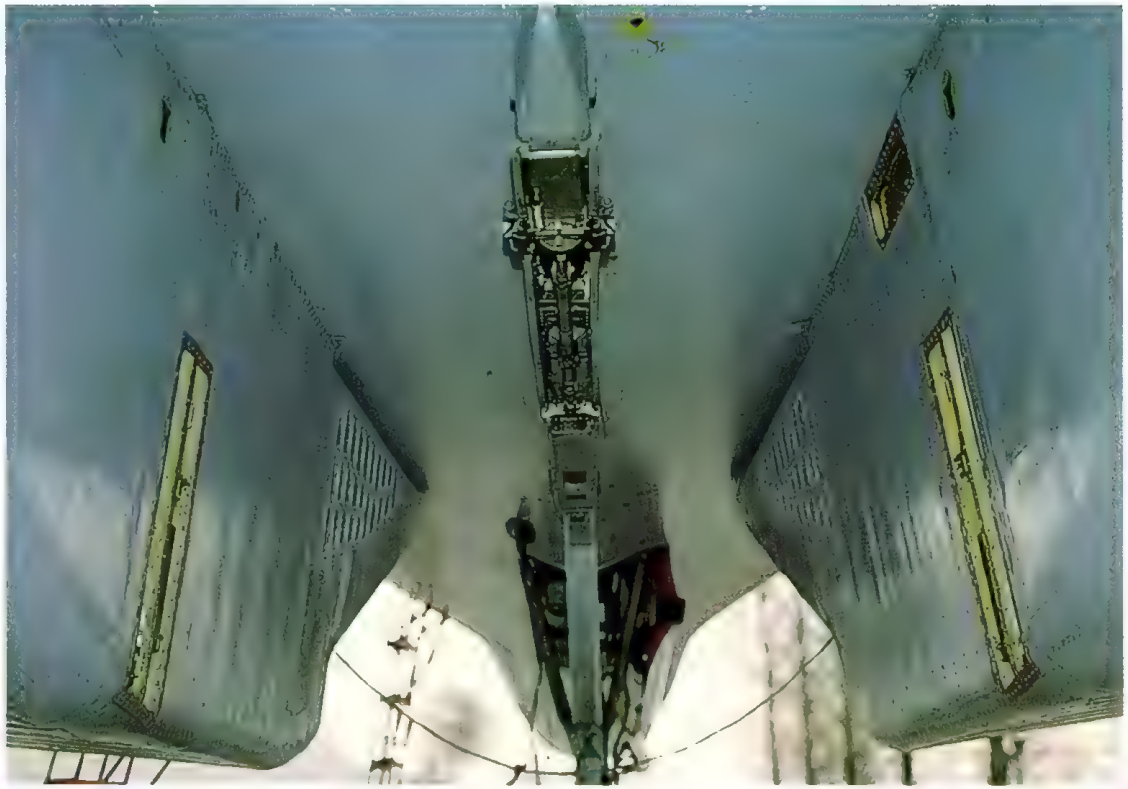


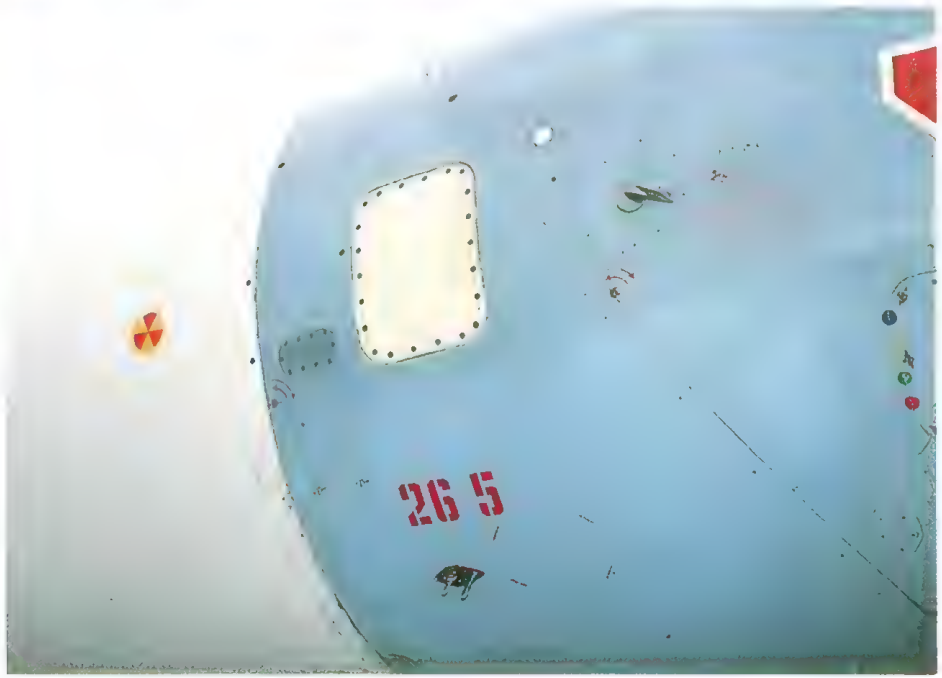
Underwing pylons are integrally interchangeable, made clear when comparing the photo at left with those on page 9.

Wide space between the engine nacelles provides space for two additional, centrally located pylons to the bottom fuselage with the most aft pylon (seen below) partially submerged in the empennage frontal strake. The hydraulic ground support hook-up is located in front and to the right of this pylon as shown below. Note the interior color of the hatch and both quick release windows in same.



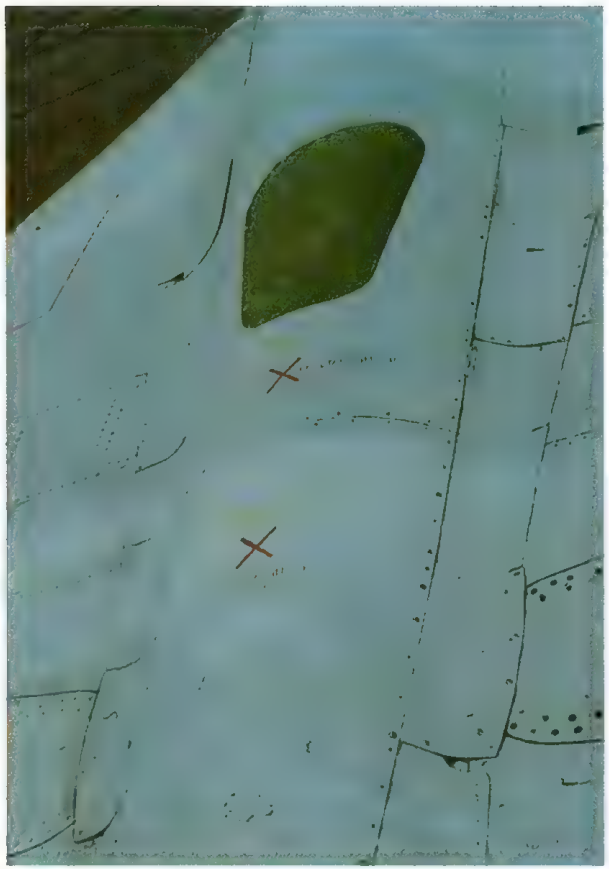
The second pylon can be found between the engine intakes next to the intake FOD screen actuators (panels removed for inspection). Similar to the outside bleed air slots, the inward intake lips are equipped with these airflow and shock wave control openings, providing adequate airflow at high angles of attack (AOA) during combat maneuvering.
Note the structural strenghteners on the emennage/fuselage joint in the bottom left picture and the left forward nose detail with dielectric panel in the remaining photo on this page.



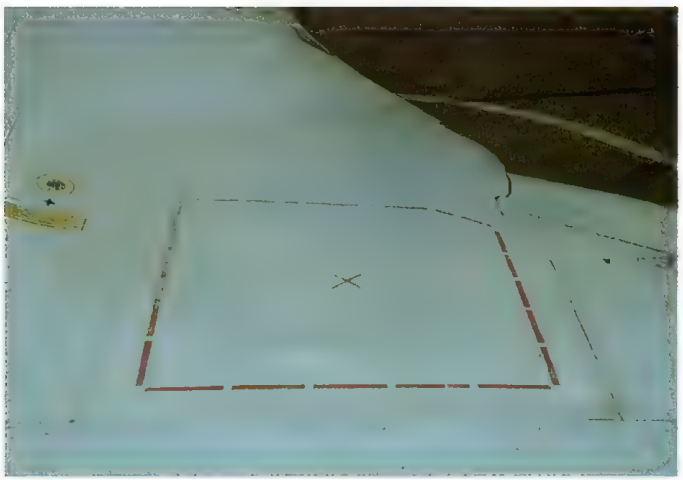


A large infrared search and track (IRST) sensor (almost identical to the one used on the MIG-29) partially obscures pilot's forward view because of its installation in a faired housing immediately ahead of the windscreen (offset to the right on the MIG-29).
It has a day/night air-to-air search and track capability and is an integrated part of the onboard laser rangefinder for both air-to-air and air-to-surface modes of firing.
However, it does not provide target identification capability and has only limited air-to-surface capability.

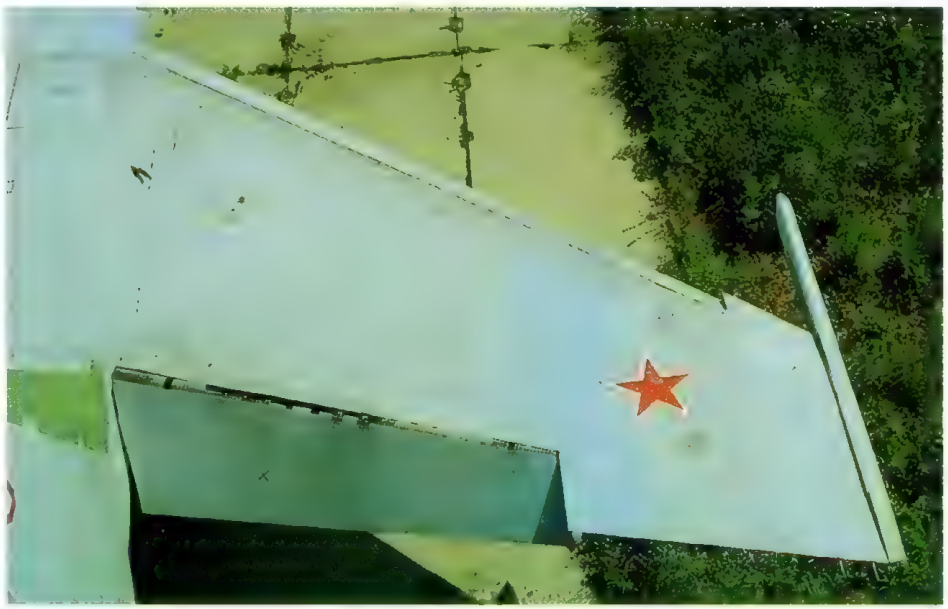
Spinal mounted blade antenna and a small white bulb can be found immediately behind the canopy, followed by the main fuselage filler cap for the T-1 (TS-1 or TC-1 as marked) kerosene fuel.

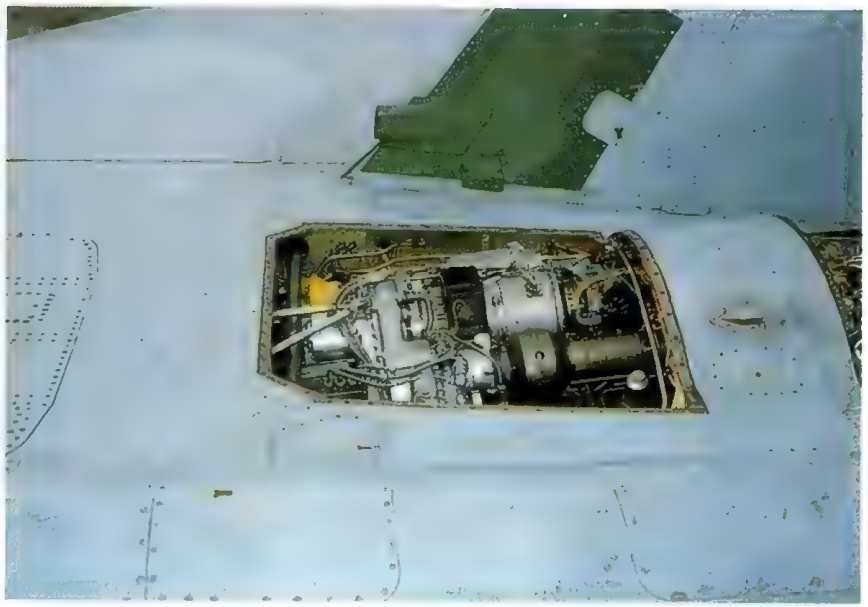


The Sukhoi has very few quick release panels and maintenance or small repairs inevitably requires unscrewing of many bolts as demonstrated at far left. The blending from central upper spine to wing area is built up using small segmented panels of various shapes and sizes instead of a single convex panel. A large green dielectric antenna panel is located aft of the speed brake. Outer wing fuel tanks are filled through a single fuel filler cap shown at bottom right. Note the wing hoisting point some 50cm to the front.

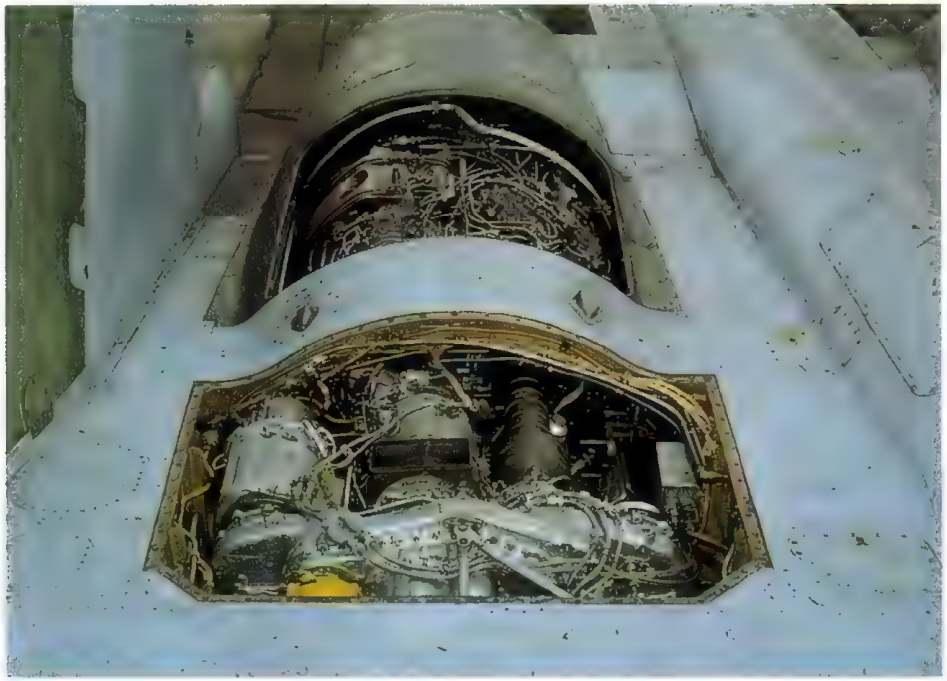


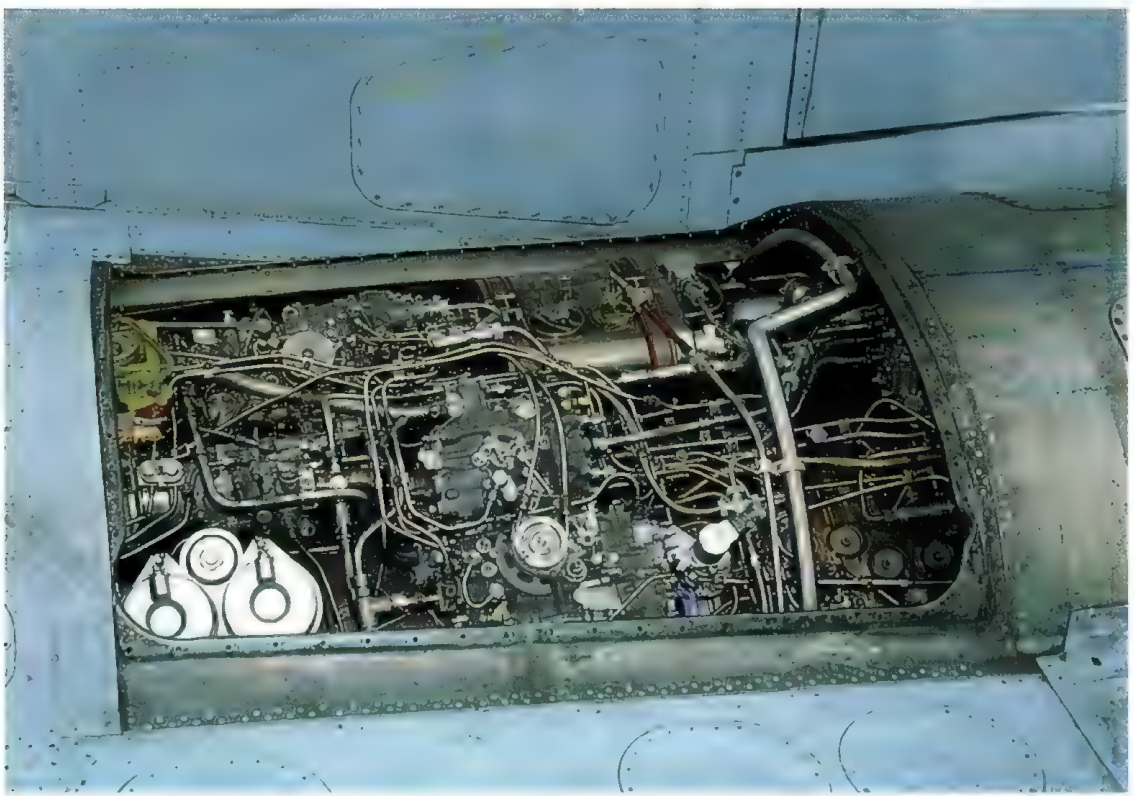
Forward right fuel tank position indicated by its filler cap at far left. Note the simple cross and dotted red line marking a NO STEP area and the absence of any inscription on this fairly large panel.





All auxiliary engine components can be reached from above, using the upper fuselage as working platform. The top right picture provides a detailed look on the flaperon actuating system and the air intake on the bottom of the vertical tail leading edge.



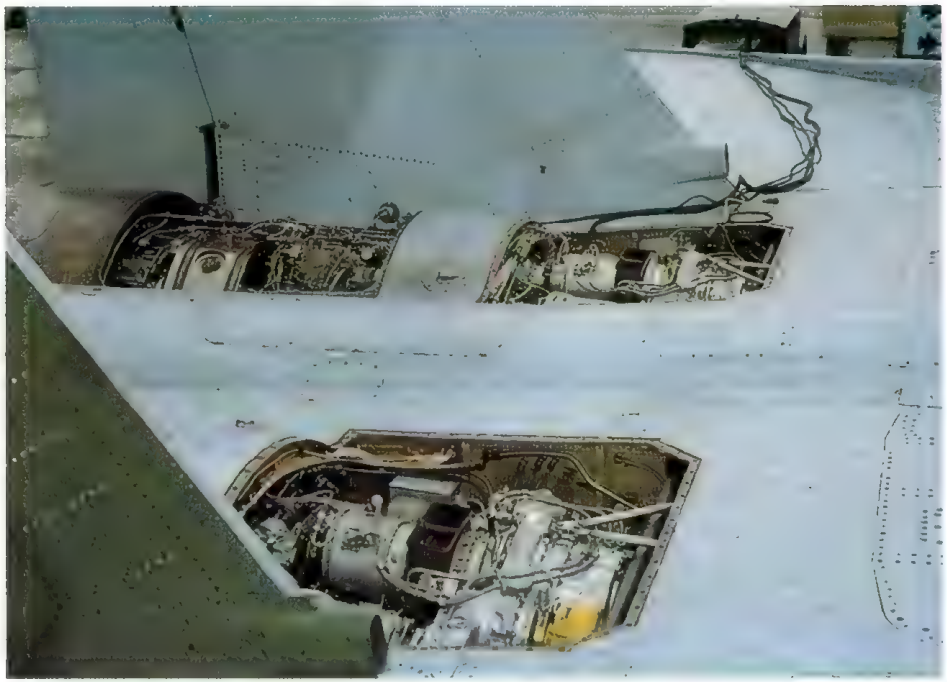


Above Judging from the number of fuel filler caps, the Su-27's fuel capacity justifies its estimated maximum radius of 2,485mi or 4000 km at cruising speed.

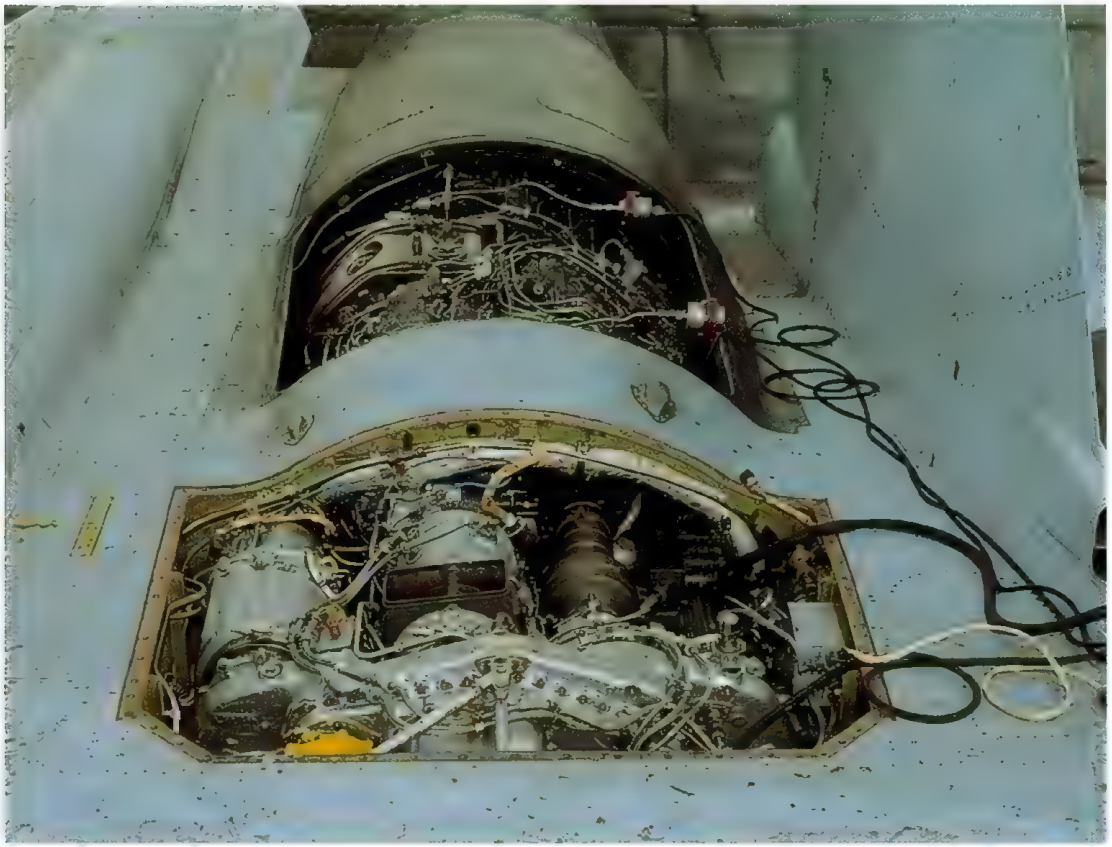
The Su-27 is powered by two Lyulka AL-31F turbofan engines (with single stage afterburner) rated at 27,500lbs of thrust each. The control system is hydraumechanical and interactively controlled by the fly-by-wire control system. Left and right side engines are interchangeable and have an estimated time between overhauls (TBO) of 1,000hrs.

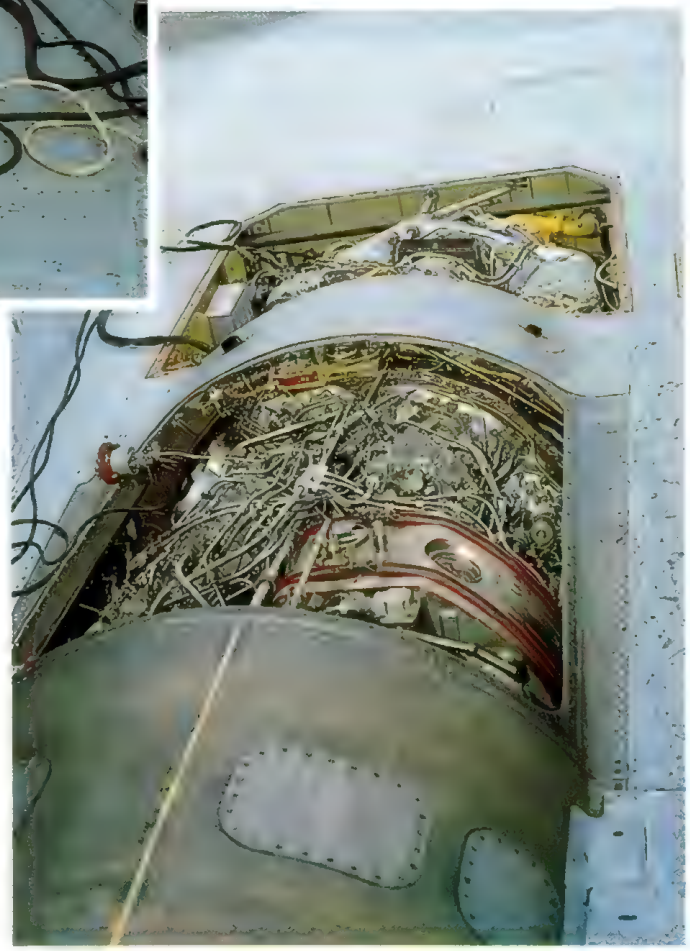
More fuel filler caps and up to thirty-two 3-shot chaff/flare cannisters are integrated in the extended tail cone, ahead of the early warning (EW) antenna and empennage chines.

Upper tail cone detail related to the drag chute carried inside. Note the oval inspection panel next to the EW antenna.



The advantages of the heat-resisting titanium to cage the engines are equally appreciated by Soviet and western aircraft designers, both using this material to cover the aft part of the engine nacelle.
Because of its narrow aft fuselage cross section, large nacelles were needed to accept the 48 inch (1220mm) in diameter engine which also has an overall length of 195 inch (4950mm).
A small dark gray panel was installed between the engine nacelle and the vertical tail.

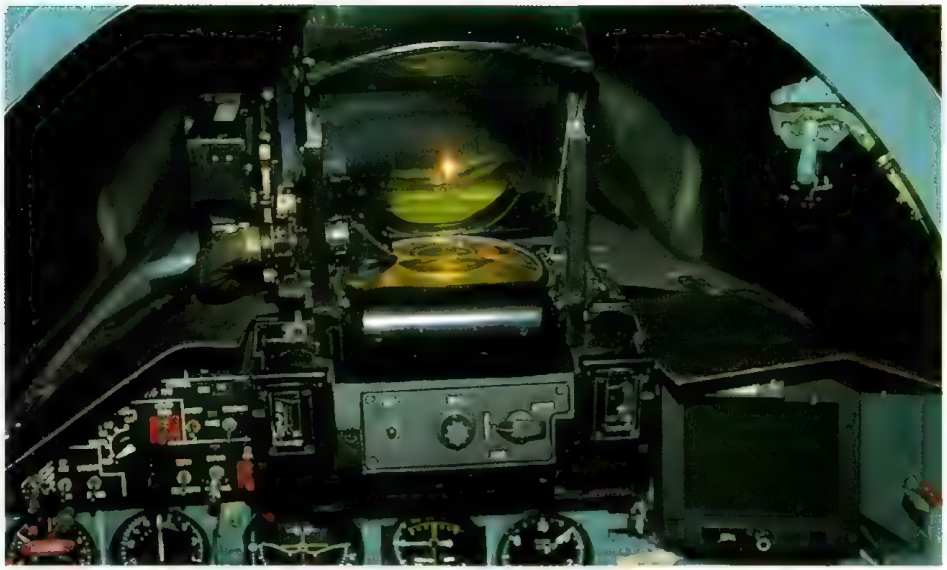




Routine engine inspection occurs after approximately 100 hours of operational flying, involving borescopic testing of the intake fan, oil analysis, replacing filters, etc. . Complete engine replacement usually occurs every 3000 hours.
Again, panel layout is quite complex with strangely shaped hatches and panels covering the various systems. Modelers should note the extensive wear and tear on either side of the top engine nacelle caused by mechanic's boots. Also note both exhausts scoops on the solid center section facing aft.

Long time mystery revealed in large size and full color, the Sukhoi Su-27 cockpit with HUD (Head Up Display) and CRT display at right. A weapons pylon selector panel is located immediately below the HUD. Despite its fairly new design the cockpit instrumentation is almost totally analog and rather spartan. Although a side-stick flight control unit is considered in future Su-27 designs this one still features a conventional center-mounted control stick with numerous buttons and switches to operate various systems. Quite unique is the so-called "panic button" on the stick, activating the autopilot when the pilot feels he is in a "no recovery" situation. The autopilot then returns the aircraft to straight level flight.

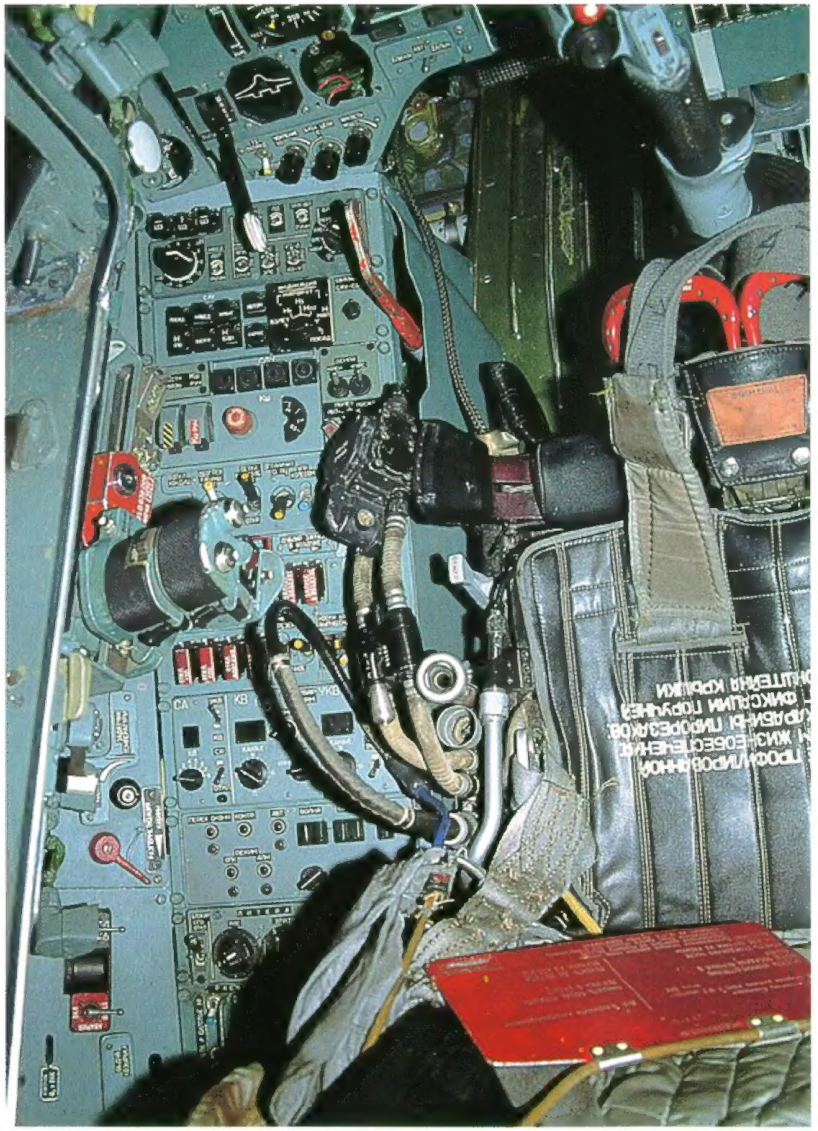
Interior color is bluish gray with black instruments. Note the oversize HUD almost touching the upper windscreen frame, the standby compass attached to the latter (at right) and the cabin ventilation nozzle at the bottom of the frame.



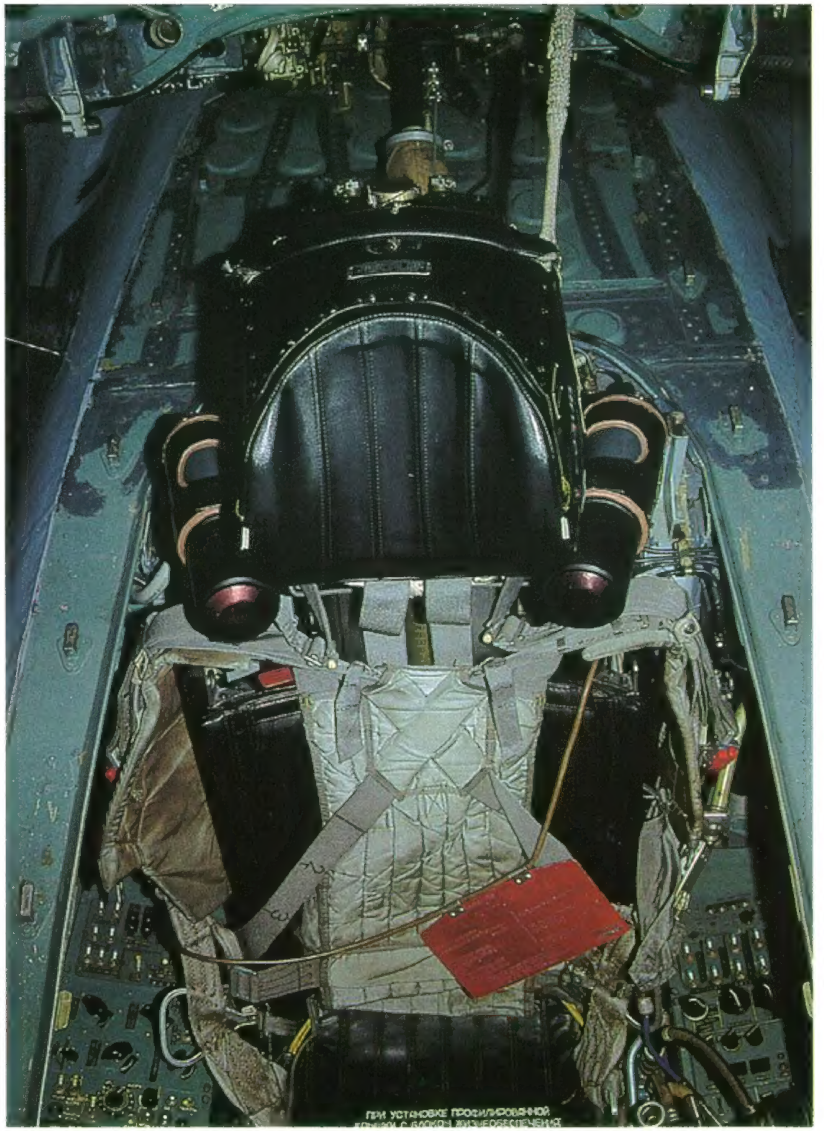
A head-on look at the instrument panel with the flight instruments framed inside a white "T". Engine monitoring instruments are at center right with fuel flow indicator and system warning indicators at far right. Note the relative small gear downlock handle at bottom left of the main instrument panel. The radar CRT (Ray Cathode Tube) displays data obtained through the IRST outside the front windscreen.

The cockpit floor and pilot's foot rest is painted green over a primer basecoat as the chipping of the paint shows. The cyrillic inscriptions on the black leather seat cushion are still intact, indicating the seat must have been installed only recently. Unlike western ejection seats which usually have a rubberlike black/yellow ejection seat handle, the handle seen here between the pilot's legs is made of metal and painted bright red. Note the numerous olive green oxygen hoses and communications connectors on the left side of the seat.

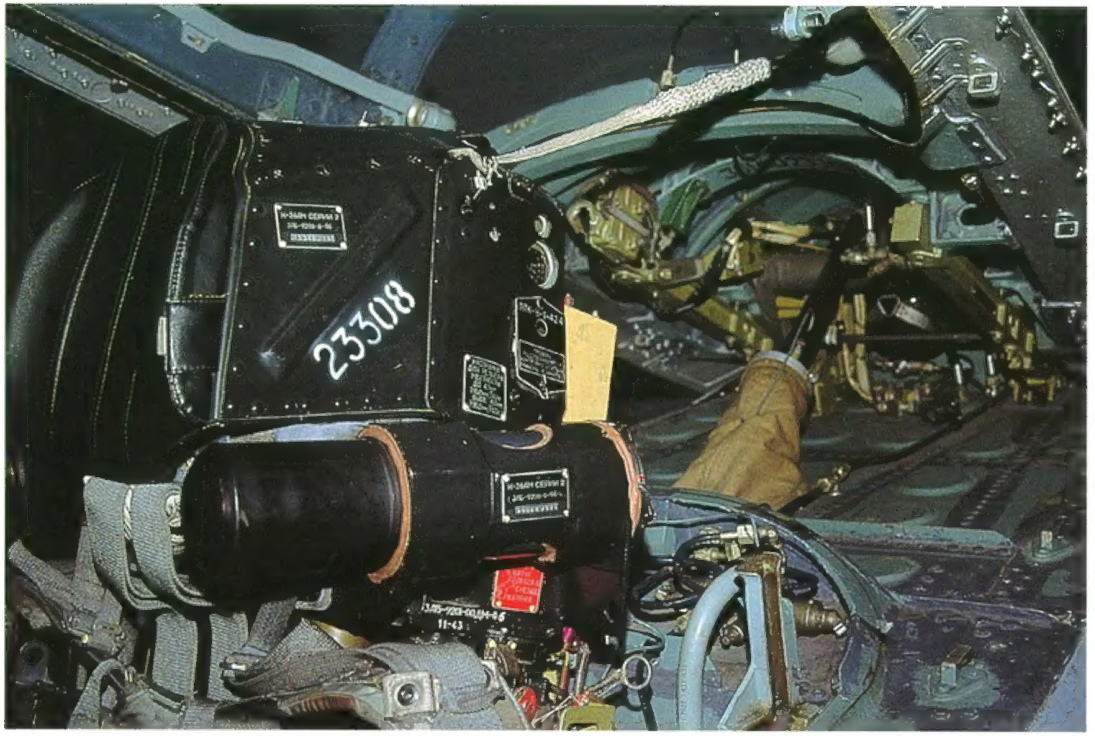
The bottom right picture shows quite a handful of stick with trim button and weapon selector switches. The size of it is mainly due to the less sophisticated control components used as compared with the F-15 and F-16 stick.



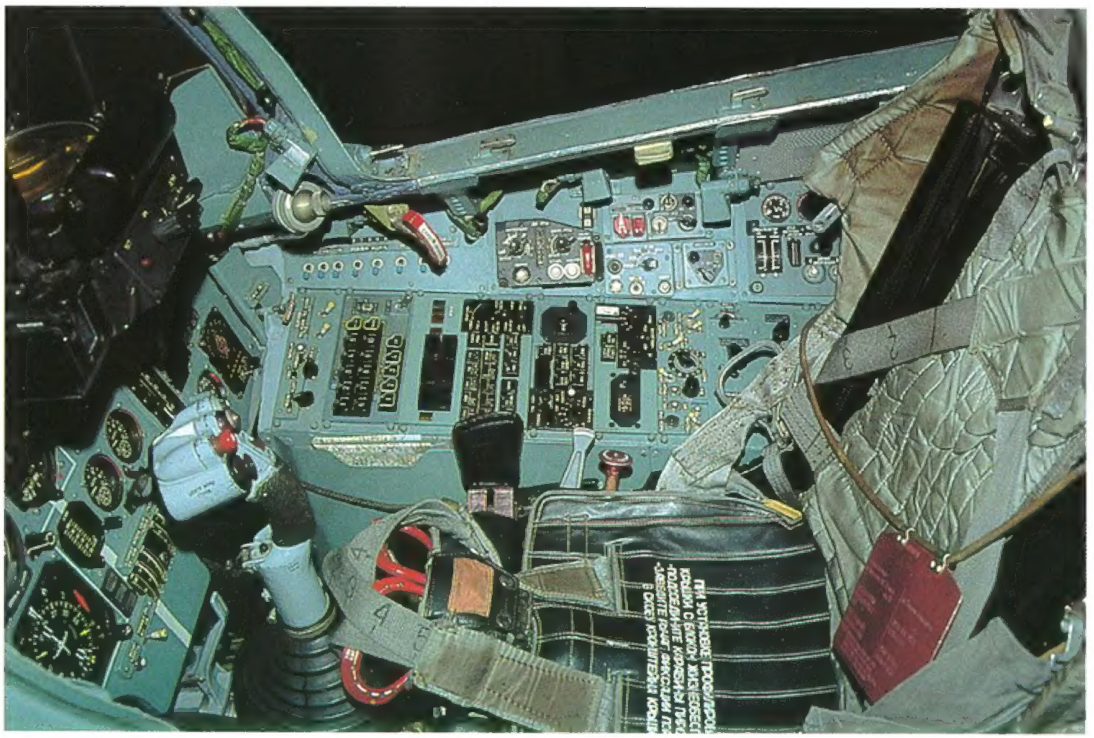
Left side console with sidewall-mounted throttle quadrant and control panels for engine, radio compass, oxygen mix, flap control and other accomodations. Note the throttle is a two-piece unit able to control thrust setting for left and right engine seperately. Note the leg support of the ejection seat at front left and the red metal lever to the sidewall close to the main instrument panel.



Overall view of the K-36MD zero-zero ejection seat and the automatic seat harness positioning the pilot in the optimum ejection position. Side spread limiters, shoulder and waist straps and leg straps are all made of a light gray fabric. Mounted on each side of the main headrest (holding the recovery chute) are two stabilizing drogue chute housings. Adequate air supply is provided in the emergency kit, even for submerged ejections.



A look at the area behind the ejection seat and the canopy actuator. Note the contoured canopy seal and the various colors of the components.



Right side console holding environmental system control panels, radar warning panels, navigation monitoring panels and some weapon system control panels. The Su-27 cockpit is quite spacious as can be judged from the wide second side panel angled to face the pilot. Note the cockpit strobe lights and the perforated panel aft of the seat, probably a loudspeaker.

Leader and his wingman on a routine training mission at high altitude. They are finished in the standard three-tone camouflage pattern of light gray, dark gray and light blue with green radome and dielectric panels.

Sukhoi Su-27
'Flanker A'
Soviet VVS

VP
the world in scale